① $f(x) = -\sin x$ $\quad f'(x) = -\cos x$

$f(\pi) = 0$ $\quad f'(\pi) = 1$

tangent: $y - 0 = 1(x - \pi)$

Normal: $y - 0 = -1(x - \pi)$

② $h'(x) = (3x^3 - x^2 + 10x + 2)(-\sin x) + \cos x(9x^2 - 2x + 10)$

③ $y' = \dfrac{(2x-3)(6x) - (3x^2-2)(2)}{(2x-3)^2} = \dfrac{12x^2 - 18x - 6x^2 + 4}{(2x-3)^2}$

$= \dfrac{6x^2 - 18x + 4}{(2x-3)^2} = \dfrac{2(3x^2 - 9x + 2)}{(2x-3)^2}$

④ $y' = f(x) \cdot g'(x) + g(x) \cdot f'(x)$

$y'|_{x=1} = f(1) \cdot g'(1) + g(1) \cdot f'(1)$

$= 3 \cdot (-2) + (1)(4) = -2$

⑤ $y' = \dfrac{g(x) \cdot f'(x) - f(x) \cdot g'(x)}{(g(x))^2}$

$y'|_{x=1} = \dfrac{g(1) \cdot f'(1) - f(1) \cdot g'(1)}{(g(1))^2} = \dfrac{1 \cdot 4 - 3 \cdot (-2)}{(1)^2} = 10$

⑥ $y = x^4 \cdot g(x)$

$y' = x^4 \cdot g'(x) + g(x) \cdot 4x^3$

$y'|_{x=1} = (1)^4 \cdot g'(1) + g(1) \cdot 4(1)^3 = 1(-2) + (1)(4) = 2$

(7) $y = \dfrac{x^3 - 2x}{g(x)}$

$$y' = \frac{g(x)(3x^2-2) - (x^3-2x)g'(x)}{(g(x))^2}$$

$$y'\big|_{x=1} = \frac{g(1)(3(1)^2-2) - (1^3-2(1))g'(1)}{(g(1))^2} = \frac{1(1) - (-1)(-2)}{1^2} = -1$$

(8) $f'(x) = x^3 - x^2 - 2x$

$f'(x) = 0$

$x^3 - x^2 - 2x = 0$

$x(x^2 - x - 2) = 0$

$x(x-2)(x+1) = 0$

$x = 0 \quad x = 2 \quad x = -1$

f has horizontal tangents at $(0,0)$, $(1, -\frac{13}{12})$, $(2, -\frac{8}{3})$

(9) $f' = x^3 - x^2 - 2x$ $\qquad f(-2) = 4 + \frac{8}{3} - 4 = \frac{8}{3}$

$f'(-2) = -8 - 4 + 4 = -8$

normal slope $= \frac{1}{8}$ $\qquad \boxed{y - \frac{8}{3} = \frac{1}{8}(x+2)}$

(10) $$f' = \frac{(x-1)(6x) - (3x^2)(1)}{(x-1)^2} = \frac{6x^2 - 6x - 3x^2}{(x-1)^2} = \frac{3x^2 - 6x}{(x-1)^2}$$

$$f' = \frac{3x(x-2)}{(x-1)^2}$$

(11) $f' = (3x^2)(\cos x) + (\sin x)(6x)$

$f' = 3x^2 \cos x + 6x \sin x$